A METHOD OF TEACHING ECONOMIC BOTANY

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It may be of interest to put on record a brief synopsis of the method of work in economic botany which I have worked out for Hunter College in New York City—aided by assistant teachers. The course is known as Biology 12, extends through one semester, and occupies 3 hours a week (or 5 when practicable). Students taking this course are young ladies, most of whom expect to teach in the public schools of this city. The conditions under which we work include the following: from 130 to 200 students to be provided for, to be met in divisions or laboratory-sections planned for 20 each, which are supplemented by lectures before a combination of sections, with some use of lantern, and with exhibition of specimens additional to those of laboratory or class use.

The students to be considered are city residents; and as usual with city residents, they have little opportunity for knowledge of the country or of the details of our flora. The other subjects of their college course call for about four fifths of their time or more, and prevent the use of sufficient time in excursion-work to give much of the desired knowledge of natural habitat. Excursions and field-work are taken, but necessarily the principal work is in the class-room.

The relation of this course to others in the college is that it forms the second among the five half-year courses in botany required from all students who select the natural science department. The succession of these required courses is: first, systematic botany (our Biology 11), February to June, with study of morphology and classification of Gymnosperms, Monocotyledons, and spring-flowering Polypetalae; second, economic botany (Biology 12), uses of plants combined with study of Gamopetalae, and with fall-flowering Polypetalae and Apetalae; third, plant physiology

(Biology 13); fourth, Lower Cryptogams; Algae and Fungi chiefly (Biology 15); fifth, Higher Cryptogams, with comparison and review of Spermatophytes (Biology 16).

In planning this sequence, Biology 11–16, it has been my effort to promote both the knowledge and the love of plants, and to arrange each course so that it shall provide individual work from fresh specimens. I also deem it axiomatic that the student's earlier botanical studies should proceed from the known to the unknown; and, therefore, that flowering plants should be quite well understood before beginning detailed work with cryptogams.

In planning this particular portion, Biology 12, our introduction to economic botany, there are also the following special objects:

First, that the student obtain systematized knowledge of the relation of the plant-world to man's use—the special province of economic botany.

Second, that this knowledge be accompanied by distinct conceptions of the plants which furnish economic material; of their names, appearance, habitat, and structure; also of their relationships. Therefore we study them in a sequence of families.

Third, that, so far as possible, our local plants be used as basis for study. Therefore our sequence of families is such as will yield fresh material during the weeks of this course, beginning in September, and avoiding the use for class purposes of any but abundant plants (for our rare plants, and any others which are liable to extermination, should never be gathered for class study.)

Fourth, that foreign plants also should be shown or illustrated, as supplementary matter.

To secure these objects I have arranged a sequence of topics which presents in succession the economic relations of families of plants available in autumn in the vicinity of New York City. It might also be used in its entirety or with appropriate modifications, in many other cities.

I have considered the course as forming properly the second half of a first year in botany; in which year the first half, which with us begins with February, is an introduction to systematic botany (our Biology 11), consisting of studies from seeds and plants, in laboratory and in the field, proceeding from germination-work and the Gymnosperms, through the Monocotyledons and many of the Polypetalae.

Therefore I have deemed it essential to this following course in economic botany that it be based on native fall flowers; that it must cover gamopetalous families with some additions of fall-blooming polypetalous and apetalous families; must include morphological characters but devote emphasis to utilities; must not be confined to succession of families by affinity, but must be influenced in its succession by blossoming-time and availability of material.

With these provisions as requisites, the following is an available approximate order of material used for class work, as now tested for four or five years.

Utilizing the opportunities given by the fall-flowering Gamopetalae, classes take up families somewhat in the following succession:

1. Labiate families; as Scrophulariaceae, Labiatae, Bignoniaceae; with references also to Acanthaceae, etc.
2. Kindred non-labiate families; as Boraginaceae, Polemoniaceae, Convolvulaceae, etc.
3. Orders showing tendency to coalescence in stamens; Cucurbitaceae, Campanulaceae, Lobeliaceae.
4. Coalescence in heads (or cymes); from Hamamelidaceae, Caprifoliaceae, Rubiaceae, to Platanaceae, Valerianaceae, and Dipsacaceae.
5. Coalescence in both stamens and heads; Compositae, Cichoriaceae.
6. Apetalous weedy families; as Ambrosiaceae, Chenopodiaceae, Amarantaceae, Polygonaceae, Plantaginaceae, Phytolaccaceae; with a glance at Euphorbiaceae.
7. Gamopetalous rotate-flowered families; Solanaceae, Apocynaceae, Asclepiadaceae; noting also Gentianaceae and Oleaceae.
8. Polypetalous families; flowers available in fall; as Cruciferae, Leguminosae, Cactaceae; and, fibre available, Malvaceae, Linaceae, Tiliaceae.
9. Apetalous tree-bearing families; Urticaceae, Juglandaceae, Cupuliferae, Betulaceae.

From point of view of their economic relationships, these families have meanwhile yielded subjects of study, approximately in this order:

A. Medicinal plants, sedatives, stimulants, condiments, healing-agents (many of *Scrophularia* and Labiate families).

B. Inert related plants, and associated plants chiefly useful as garden flowers, from the previous, and *Bignonia*, *Verbena*, *Phlox* families.

C. Foods derived from fleshy roots (Sweet Potato) or fleshy fruits (Cucurbits) with glance at the reductions in related parasites (Broom-rape, Dodder) and in submerged plants (*Utricularia*).

D. Beverages and drinks; from Rubiaceae; comparison of tea, chocolate, etc.; consideration of caffeine, quinine.

E. Bitters, herb-teas, folk-medicine; Compositae (with comparison of Gentianaceae).

F. Salad-plants; Cichoriaceae, and comparisons.

G. Weedy plants, their values, their control; reasons for their prevalence; Compositae and Apetalae.

H. Alkaloids and other drugs and important vegetable poisons; Euphorbiaceae, Solanaceae, Apocynaceae, Asclepiadaceae.

I. Oils and perfumes; Oleaceae, Linaceae, etc.

J. Dyes; Leguminosae, and families following.

K. Fodder; Leguminosae.

L. Food from seeds; Leguminosae, Buckwheat, Sunflower, Southwestern Amarantaceae, etc.

M. Food from roots, leaves, etc.; Cruciferae.

N. Mucilage and emollients; Malvaceae, Linaceae, Tiliaceae, Ulmaceae.

O. Fibre, paper, etc.; the preceding families, Moraceae, Urticaceae, etc. Comparison of tissues, with microscope.

P. Rubber, latex; *Ficus*, etc.

Q. Tannin and cork; Cupuliferae.

R. Nuts; Juglandaceae, Cupuliferae.

S. Forests, their value, relation to rainfall, and distribution.

T. Forestry methods, their history in Europe, India, United States, etc.; the present United States Government Forest Reserves.

I add to the above one further explanation; that cereals, most fleshy fruits, and berries are not omitted by accident, but are studied in Biology 11, with the Monocotyledons and Spring Polypetalae.